Plume Tracker: Interactive Mapping of Atmospheric Plumes via GPU-based Volumetric Ray Casting

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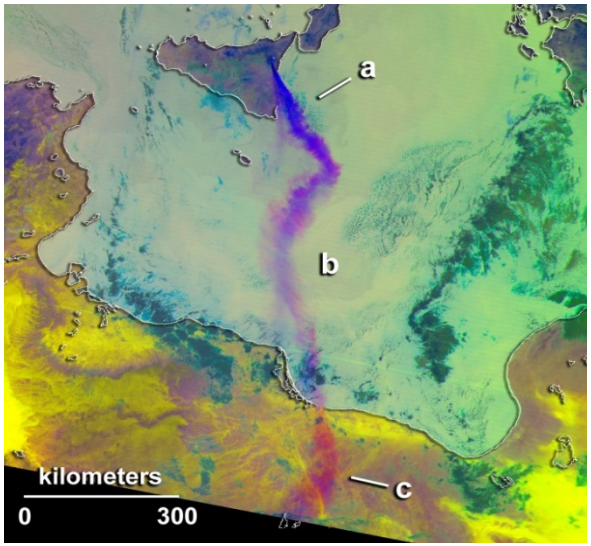
Objective

- Real-time quantification of volcanic gaseous and particulate releases from analysis of satellite-based Thermal Infrared (TIR) spectral imagery data
- Real-time visualization of the impact of changes in model parameters on the fit between observed and model radiance spectra.
- Accelerated implementation of MODTRAN (atmospheric and plume radiative transfer model) TIR radiance algorithms integrated into an interactive toolkit for retrieving and mapping the 3-D composition of atmospheric plumes using JPL-established retrieval algorithms.
- Achieve 100-fold run-time reduction of radiative transfer calculations vs. state-of-the-art MAP_SO2 model.



MODIS-Aqua false color image of Mt. Etna eruption plume.

Spectral variations between (a) proximal, (b) mid-range, and (c) distal regions of the plume are due to changes in plume composition and atmospheric and surface conditions.

Approach

Develop Plume Tracker with its accelerated MODTRAN TIR radiance and multi-threaded retrieval algorithms by:

- Introducing single-pass Brent Minimization
- Rewriting Plume Tracker retrieval manager in C/C++ with OpenMP
- Scaling radiances to model surface variations
- Eliminating redundancies in MODTRAN processing
- Generating Region Of Interest (ROI) look-up tables
- Implementing a GPU-based retrieval algorithm
- Continually validating against ground and balloon-based measurement data

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Key Milestones

• Obtain scale surface results, create Transmitting Upwelling Downwelling (TUD) hash tables	01/14
• Implement OpenMP Retrieval Manager	07/14
• Eliminating Redundant Calculations	07/14
• Develop and employ ROI-specific look-up tables	09/14
• Implement GPU-based retrieval algorithm and validate against CPU version	11/14
• Full system validation	03/15

$TRL_{in} = 2$ $TRL_{current} = 2$